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CASTILLEJA KERRYANA (OROBANCHACEAE): A NEW SPECIES FROM THE ROCKY MOUNTAINS OF NORTHERN MONTANA

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ABSTRACT

Castilleja kerryana J.M. Egger, **sp. nov.**, is described from the Scapegoat Wilderness Area, Lewis & Clark County, Montana. It is distinguished from similar species by a combination of decumbent-ascending stems, brightly colored, predominantly reddish to salmon, coral, crimson, or violet-magenta calyces and bracts, and conspicuously exserted corollas with unusually long tubes, relatively much shorter beaks, and petaloid, contrastingly colored teeth on the lower lips. The new species is known only from gravelly alpine slopes and ridges in mesic to somewhat xeric turf and krummholz communities on strongly limestone substrates, where it is closely associated with and likely at least partially parasitic on *Dryas octopetala*. While locally fairly common, the new species is a very narrow endemic, and its conservation status is in need of further evaluation.

KEY WORDS Orobanchaceae, Castillejinae, *Castilleja kerryana*, Montana flora, new species, sensitive species, Scapegoat Wilderness Area, Lewis and Clark National Forest, Lewis and Clark County

In late July 2009, Peter Lesica (MONTU) and Dave Hanna (The Nature Conservancy) collected an unusual *Castilleja* species on an alpine ridge SE of Flint Mountain in the Flathead Range of the Rocky Mountains, close to the continental divide and near the center of the remote Scapegoat Wilderness Area, in Lewis and Clark Co., Montana. Likely due to its long, partially exserted corolla tubes, Lesica tentatively identified it as *Castilleja crista-galli* Rydb., but, uncomfortable with this determination, he began to distribute photos of the plants to other botanists. In March 2010, Lesica sent me a photo of the plants, which I soon realized were unlike any *Castilleja* species with which I was familiar and that it was likely an undescribed species. Later examination of a sheet of their collection (*Lesica 10,216*, WTU) and additional photos provided by Hanna confirmed the unique combination of characters in the new species.

Conflicting schedules prevented a visit to the Scapegoat area in 2010, but from 29 July-1 August 2011, I joined Lesica, Hanna, and others on a pack trip into the area where the plants were located, known as the Scapegoat Plateau, a beautiful, relatively pristine and expansive alpine-subalpine region of predominantly Cambrian limestone substrates (Mudge & Earhart 1983). Working in small teams, we spread out into the higher elevation mountains and ridges surrounding the Scapegoat Plateau and eventually located and documented five separate populations and several sub-populations of the new species, collecting vouchers for each, including the type collection described below. Additional, previously undetermined or misidentified collections of the new species were also located at MONTU and RM, documenting two additional populations from the general vicinity of the Scapegoat Plateau.

CASTILLEJA KERRYANA J.M. Egger, **sp. nov.** (Figs. 1-4). **TYPE: USA. Montana.** Lewis and Clark Co.: Lewis and Clark National Forest, Scapegoat Wilderness Area, Rocky Mountains, Flathead Range, saddle area on summit ridge of Flint Mountain, moist to dryish stony alpine ridge with entirely limestone substrate, almost always in association with and probably parasitic on *Dryas octopetala*, ca. 8600 ft, 31 Jul 2011, *M. Egger 1500* with J. Owen (holotype: WTU; isotypes: GH, MO, RM, US).

Similar to *Castilleja fraterna* Pennell and to *Castilleja pulchella* Rydb. but differing from both in its combination of decumbent-ascending stems, brightly colored, predominantly reddish to salmon, coral, crimson, or violet-magenta calyces and bracts, and conspicuously exserted corollas with unusually long tubes, relatively much shorter beaks, and lower lips with three longitudinally grooved, bilobed, slightly inflated pouches with petaloid, contrastingly colored distal teeth.

Plants perennial from branching, woody caudices with pale yellow roots. **Stems** mostly 1–10 in flower, with a variable number of much shorter, vegetative stems; unbranched, short-decumbent proximally, becoming upright-ascending distally, 5–18 cm long in flower, dull greenish to dull reddish or purplish-brown, usually conspicuously villous with a mixture of shorter, stipitate-glandular hairs and longer, non-glandular hairs. **Leaves** sessile, relatively few, 10–70 mm long, 1–5 mm wide, linear to linear-lanceolate or narrowly lanceolate, distally acute-tipped, greenish to dull-purplish brown, villosulous with a mixture of shorter, stipitate-glandular hairs and longer, non-glandular hairs, entire on the proximal portion of the stem, becoming 3-lobed at a variable point below the inflorescence or occasionally all entire, the spreading to ascending lateral lobes usually branching from the distal half of the blade and linear-lanceolate to narrowly long-triangular, acute-tipped, and usually shorter and narrower than the central lobe. **Inflorescences** densely ranked, subcapitate spikes, 3–7 cm long, 2–5(–8) cm wide in mid-flowering, elongating somewhat with age; flowers few to many, densely imbricate, sessile to very short-pedicillate; prominent coloration borne primarily on the conspicuous calyces and to a lesser and variable degree on the distal bracts, with colors ranging through shades of red, scarlet, crimson, red-orange, coral, salmon, salmon-pink, red-magenta, and violet-magenta, to very occasionally yellowish (Figs. 5-6) (note: some reddish forms dry dull purplish on herbarium sheets). **Bracts** diverging quickly from the leaves, though the most proximal rank often leaf-like, elliptic to oblanceolate or obovate, 15–30 mm long, 10–25 mm wide, usually significantly shorter than the flowers, divided from about mid-blade or above into 3(–5) lobes, the central lobe broadly lanceolate-triangular with an acute to obtuse-rounded tip, the lateral lobes somewhat shorter and much narrower, spreading-ascending, linear to narrowly triangular and acute-tipped; pubescent with a mixture of short, stipitate-glandular hairs and much longer, non-glandular, villous hairs, the latter gradually decreasing in length and frequency distally; most proximal rank colored as in leaves, the rest usually brightly colored as in calyces though occasionally greenish proximally and/or on the veins. **Calyces** (23–)25–34(–37) mm long, divided adaxially and abaxially into two subequal primary lobes, each of these distally emarginate to more often shallowly cleft into two segments, 1–3 mm in length; usually brightly colored throughout or less commonly greenish proximally; pubescent with a mixture of short, stipitate-glandular hairs and longer, non-glandular, villous hairs, the latter gradually decreasing in length and frequency distally. **Corollas** (25–)28–45(–50) mm long; the tube whitish-translucent proximally, gradually becoming suffused with pigment distally, subglabrous to sparsely puberulent; beaks 8–14 mm long, adaxial surface pale greenish to greenish-yellow with contrasting thin margins colored as in calyces, minutely glandular-puberulent; lower lip 4–9 mm long, consisting of three fused, longitudinally grooved and bilobed, slightly inflated, greenish to greenish-yellow pouches, 3–5(–6) mm long, from each of which emerges distally a 1–3 mm long, spreading to appressed, narrowly triangular to linear-lanceolate, contrastingly but variably colored tooth. **Stigmas** exserted, minutely bilobed, greenish to yellow-green or colored as in the calyces. **Anthers** mostly included within and dehising from the thin margins of the corolla beak; ca. 2.0 mm in length, narrow, decurved, fully dehiscent along their entire length, stramineous. **Capsules** 8–9 mm long, 5–6 mm

wide, ovoid with a slightly curved, acuminate tip, medium brown, glabrous. **Seeds** not numerous, 1–2 mm long, ovoid, dark brownish; coat loose-fitting, reticulate, cells mostly polygonal-ovate; radial walls shallow, membranous, and unstriated; inner tangential walls membranous and unruptured at maturity.

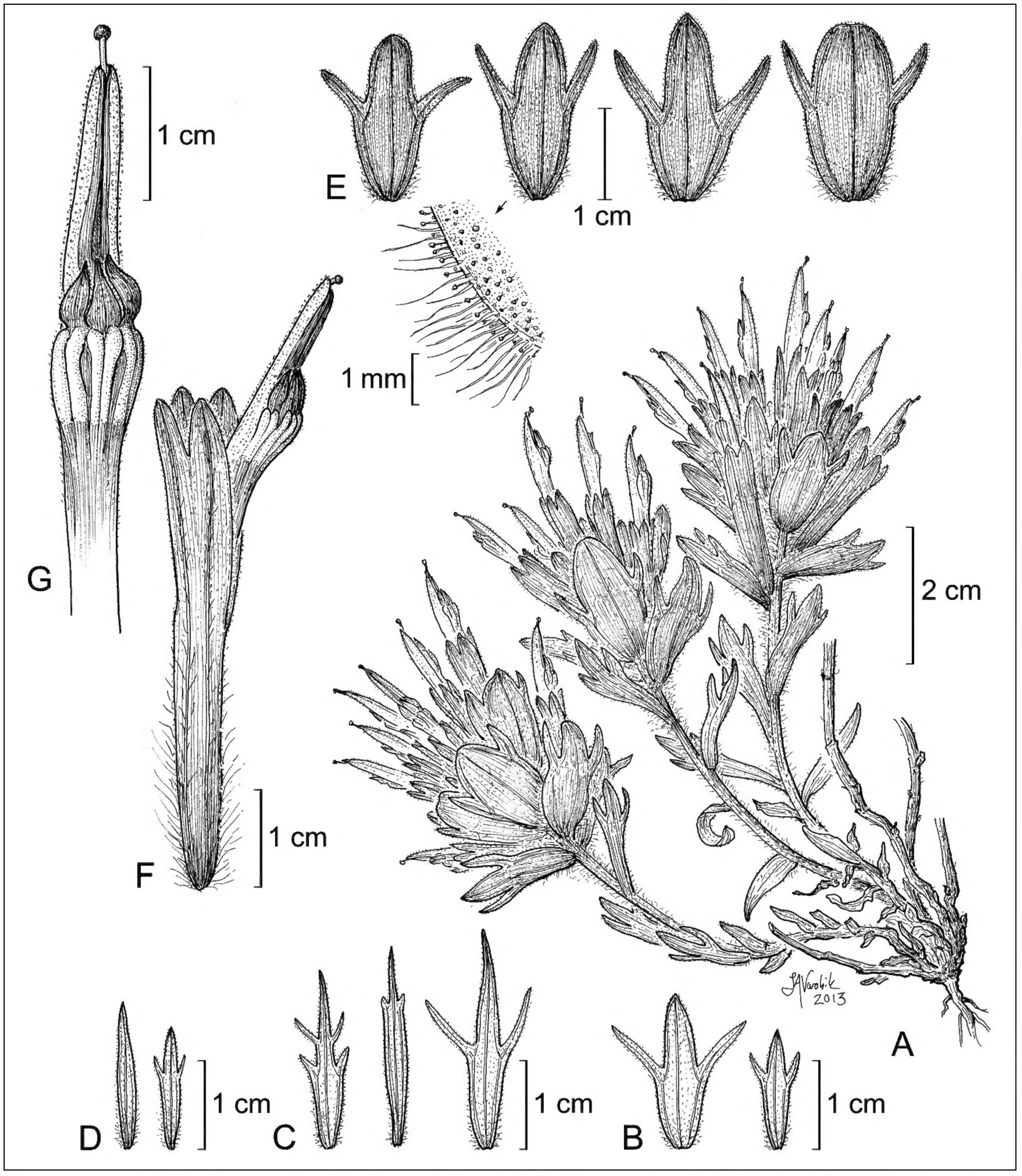

Figure 1. *Castilleja kerryana* J.M. Egger, drawn from holotype and paratype collections (A., B., E.: *Lesica 10,680*; C.: *Lesica 10,672*; F., G.: *Egger 1500* and Owen). **A.** Habit; **B., C., D.** Leaf variation; **E.** Bract variation and pubescence detail; **F.** Flower, lateral view; **G.** Corolla, ventral view.

HERBARIUM OF
384659
UNIVERSITY OF WASHINGTON
HOLOTYPE! of:
Castilleja kerryana J.M. Egger
Determined by Mark Egger, January 2012
University of Washington
Castilleja sp. nov. J.M. Egger
var. ssp.
Family Orobanchaceae
31 Jul 2011
Location saddle area on summit ridge of Flint Mountain, Scapegoat Plateau, Scapegoat Wilderness Area, Flathead Range. HOLOTYPE collection!
Pop. 3
Jurisdiction U.S. Forest Service
County Lewis and Clark
State MT
Country USA
Elevation ca. 8500'
Habitat moist to dryish stony alpine ridge with entirely limestone substrate, almost always in association with and probably parasitic on Dryas octopetala L.
Color mostly reddish, varying to pink, pale orange, magenta or crimson-magenta
Notes locally fairly common
Mark Egger & Jill Owen 1500 ft.
Distribution WTU
Photo? y

Figure 2. Holotype of *Castilleja kerryana* J.M. Egger, WTU.

Figure. 3. Portion of holotype gathering in the field, entire plant.

Figure 4. Portions of holotype gathering. **A.** Inflorescence (top). **B.** Bract, calyx, and exserted corolla (lower left). **C.** Corolla dissected from calyx (lower right).

Figure 5. Variation in coloration of inflorescences in *Castilleja kerryana*, part 1.

Figure. 6. Variation in coloration of inflorescences in *Castilleja kerryana*, part 2. Lower photo by Dave Hanna; all other photos by the author.

Castilleja kerryana is named for my daughter, Kerry Elena Egger, in hope that she may continue to live in a world filled with diverse natural forms, as well as for my sister, Kerry Marie Egger, four years a beautiful flower upon this planet.

Additional specimens examined. USA. **Montana**: Lewis and Clark Co.: Lewis and Clark National Forest, Scapegoat Wilderness Area, Rocky Mountains, Flathead Range, Scapegoat Mountain, 8,200 ft, 12 Aug 1975, *J.W. Craighead 9* (MONTU); Scapegoat Plateau, 8,200 ft, 30 Jul 1972, *D. Craighead 84* (MONTU); on the ridge 1 mi SE of Flint Mountain, T18N R10W S8, 8600 ft, 25 Jul 2009 *Lesica 10,216* with Hanna (MONTU, WTU); ridge separating Crown Creek and Straight Cr., ca. 2 air mi NE of Halfmoon Peak, T19N R9W S29, 47.3728° N 112.7818° W, 2175 m, 25 Jul 2009, *McNeill 7291* (RM); Scapegoat Plateau, ca. 1.5 air mi WNW of Scapegoat Mountain, T18N R10W S15, 47.3186° N 112.8604° W, 2385 m, 27 Jul 2009, *McNeill 7545* (RM); long, narrow spur on N end of Scapegoat Mountain above Green Fork of Straight Cr. and Halfmoon Cr., T18N R10W S11, 47.3271° N 112.8345° W, 2499 m, *McNeill 7587* (RM); N-facing slope of the ridge 0.5 mi S of Cigarette Rock, T19N R10W S34, 8100 ft, 29 Jul 2011, *Lesica 10,666* with Hanna (ID, MONTU, OSC, WTU); Scapegoat Plateau, upper subalpine slopes of SE portion of Flint Mountain, ca. 8000 ft, 30 Jul 2011, *Egger* 1498 (WTU); SW-facing slope of ridge 2 mi. E of Flint Mountain, T18N R10W S3, 8,300 ft, 30 Jul 2011, *Lesica 10,672* with Hanna (MONT, MONTU, WTU); shoulder on the N side of Scapegoat Mountain, T18N R10W S14, 9000 ft, 31 Jul 2011, *Lesica 10,678* with Hanna (MONTU, WTU); saddle between the two summits of Scapegoat Mountain, T18N R10W S24, 8,700 ft, 31 Jul 2011, *Lesica 10,680* with Hanna (MONTU, WTU).

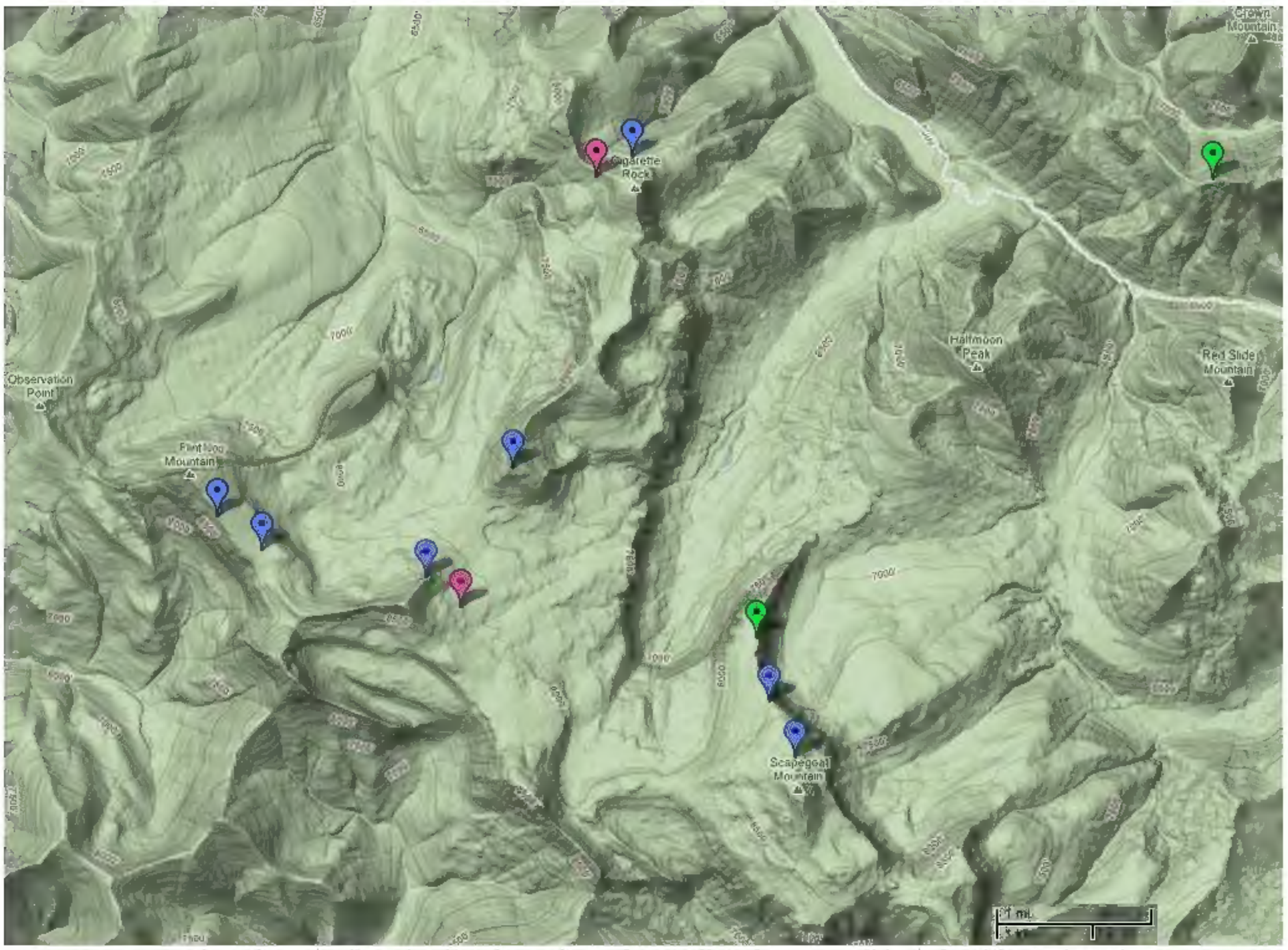

Figure 7. Camp locations (red) and collections sites of *Castilleja kerryana* (blue) for this study; other herbarium-verified collection sites (green), ©GoogleMaps.

Distribution and range

Castilleja kerryana is presently known only from the general vicinity of the Scapegoat Plateau, on and immediately east of the continental divide in the Scapegoat Wilderness Area of the Lewis and Clark National Forest, in the Flathead Range of the Rocky Mountains in Lewis and Clark Co., Montana, between 8,000–9,000 ft. (2438–2743 m) elevations (Figs. 7-8). All populations are found within T18-19N, R9-10W, in the drainages of Straight Creek and the South Fork of Sun River, both tributaries of the main stem of the Sun River.

Figure 8. Location of Scapegoat Plateau in Montana, ©GoogleMaps.

Ecology, phenology, and associated species

All known populations of *Castilleja kerryana* occur on rocky, gravelly limestone substrates of Cambrian origin (Mudge & Earhart, 1983) on consolidated slopes and ridges from upper subalpine, krummholz, often turfy communities to upper alpine fell fields (Figs. 9-10). The thin soils in which the plants grow vary from moderately mesic to moderately xeric but are uniformly well-drained. *Castilleja kerryana* has been collected in flower from 25 July to 12 August, though it likely flowers from early July to early September in typical years. Of all the collections examined, only a single plant was collected with mature fruit, so most maturing of seeds does not likely occur until well into August and early September, weather permitting. No potential pollinators, either avian or insect, were noted visiting the flowers of *C. kerryana* in the field, and we observed little if any evidence of predation on the plants by animals of any sort.

Associated species include these: *Carex rupestris*, *Carex scirpoidea*, *Kobresia myosuroides*, *Abies lasiocarpa*, *Salix vestita*, *Arenaria rossii* var. *apetela*, *Silene aculis*, *Aquilegia jonesii*, *Caltha leptosepala*, *Cardamine rupicola*, *Draba lonchocarpa*, *Physaria didymocarpa*, *Smelowskia calycina* var. *americana*, *Saxifraga oppositifolia*, *Polygonum viviparum*, *Dryas octopetala*, *Potentilla glaucophylla*, *Hedysarum sulphurescens*, *Oxytropis sericea* var. *sericea*, *Androsace lehmaniana*, *Phlox pulvinata*, *Eritrichium nanum*, *Besseya wyomingensis*, *Pedicularis bracteosa* var. *canbyi*, *Pedicularis contorta* var. *contorta*, *Pedicularis groenlandica*, *Antennaria alpina*, *Antennaria aromatica*, *Aster alpigenus*, *Erigeron lackschewitzii*, and *Senecio canus*. Of these, *Castilleja*

Figure 9. Scapegoat Mt. and Scapegoat Plateau from xeric site on upper Flint Mt. Note *Castilleja kerryana* on some mats of *Dryas octopetala* in the foreground.

Figure 10. *Castilleja kerryana*, more mesic site, type locale, upper flanks Flint Mt.

kerryana is almost always found growing within or in very close proximity to mats of *Dryas octopetala*. As a member of the hemiparasitic clade of the Orobanchaceae, it thus seems likely that *C. kerryana* utilizes *Dryas octopetala* as its most frequent if not obligate host. Examination of the roots of specimens of *C. kerryana* collected for the type gathering showed close association of the rootlets of the two species, though the process of digging up and cleaning the roots makes direct observation of haustorial connections in the field very difficult. *Castilleja kerryana* is less regularly observed growing in mats of *Antennaria alpina*.

Conservation status

Even within its very limited range, *Castilleja kerryana* is relatively uncommon and patchily distributed. However, in locations where its precise habitat requirements are met, it can be locally quite common. While its entire known range is well within an extensive, federally designated wilderness area, long-term droughts and other effects associated with global and regional climate change may adversely affect this species. Future changes in land use management, such as increased levels high elevation livestock grazing, recreational activity, and the degradation and likely incursion of noxious weed species associated with both, could potentially result in adverse effects on this species. For the present, *C. kerryana* should be considered as a range-restricted endemic and managed as a sensitive or threatened species, as currently defined by the U.S.D.A. Forest Service rare plant management regulations. Further study of the new species, particularly its genetics, range, and population trends, is recommended.

Relationships and identification

Various collections of *Castilleja kerryana* have been identified on herbarium sheets as *C. crista-galli* Rydb., *C. pulchella* Rydb., *C. rhexiifolia* Rydb., or *C. sessiliflora* Pursh., though of these only *C. pulchella* seems more than distantly related in the genus to *C. kerryana* morphologically. With their reduced, greenish, non-petaloid lower corolla lips, substantially longer corolla beaks in relation to the tubes, and much larger, upright-ascending growth forms, *C. crista-galli* and *C. rhexiifolia* are unlike *C. kerryana* and are more likely part of the complex of species surrounding the widespread *C. miniata* Douglas ex Hook. *Castilleja sessiliflora*, with its strongly falcate corollas and adaptation to desert/dry grassland habitats is most closely related to a small group of species primarily occurring at much lower elevations in the southwestern USA and adjacent northern Mexico. A key for separating *C. kerryana* from all other *Castilleja* species known to occur in Montana (Holmgren 1973; Lesica 2012; Ownbey 1959), including the species discussed above, is presented below.

Castilleja kerryana is similar in several characters to *C. pulchella*, a variable species ranging from montane meadows to lower alpine ridges in southwestern Montana to adjacent Idaho and northwestern Wyoming, as well as in the Uinta Mountains of northeastern Utah. However, *C. pulchella* is readily distinguished by its mostly included, shorter corollas and corolla beaks and by its pale yellowish to less commonly purplish coloration. It should be noted for identification purposes that some of the reddish to crimson forms of *C. kerryana* tend to dry to a dull, dark purplish color on herbarium sheets. This makes separation of *C. kerryana* from the purplish forms of *Castilleja pulchella* problematic if based solely on the coloration of the dried inflorescences.

Castilleja kerryana is also morphologically similar to and may possibly share a close ancestry with *C. fraterna* Pennell, another very narrow endemic of similar alpine limestone habitats in the northeastern Wallowa Mountains of Wallowa Co., Oregon. A detailed key for distinguishing *C. kerryana* from both *C. fraterna* and *C. chrysantha* is also presented below. The ranges of *C. kerryana* and *C. fraterna* are separated by a gap of about 420 km.

An extensive collection of images of *Castilleja kerryana* and its habitat from the vicinity of the type collection, as well as images of other *Castilleja* species discussed here (and many others) can be viewed at my Flickr photostream (Egger 2013).

Simplified key to separate *Castilleja kerryana* from the other *Castilleja* species of Montana
(see Appendix 1 for full names)

1. Plants annual, bracts entire, linear-lanceolate, and distally acuminate ..... **Castilleja minor**
1. Plants perennial, bracts other than above.

2. Calyces cleft into four subequal lobes ..... **Castilleja nivea, C. pilosa** var. **longispica**
2. Calyces cleft into two primary lobes, these distally emarginate or more commonly cleft again into two, clearly shorter segments.

3. Corolla beaks clearly greater than 1/4 the length the corolla tubes at full anthesis, lower lip of corollas unpouched, usually strongly reduced, greenish, and often incurved ..... **Castilleja angustifolia, C. covilleana, C. crista-galli, C. gracillima, C. hispida, C. linariifolia, C. lutescens, C. miniata, C. occidentalis, C. rhexiifolia, C. septentrionalis**
3. Corolla beaks clearly less than 1/4 the length of the corolla tubes; lower lip of corollas other than above.

4. Corolla beaks strongly falcate distally; plants of relatively low elevation, non-montane and primarily xeric habitats ..... **Castilleja sessiliflora**
4. Corolla beaks not strongly falcate distally; plants of higher elevation, montane to alpine, and often more mesic habitats.

5. Corolla beaks at full anthesis subequal to or clearly less than twice the length of the lower lips and included or with only the distal tip and stigma inconspicuously exserted from the calyces ..... **Castilleja cusickii, C. pallescens, C. pulchella**
5. Corolla beaks at full anthesis about twice the length of the lower lips or greater and often conspicuously exserted from the calyces.

6. Stems erect to ascending-erect; lower lips of corollas reduced, non-petaloid, and not contrastingly colored; inflorescence primarily pale to moderately yellowish, though sometimes pale reddish, especially with age ..... **Castilleja cervina, C. flava**
6. Stems decumbent-ascending; lower lips of corollas less reduced and sub-petaloid, with contrastingly colored distal teeth; inflorescence primarily reddish to crimson, salmon or magenta, only occasionally colored otherwise ..... **Castilleja kerryana**

Key to distinguish *Castilleja kerryana* from *C. fraterna* and *C. pulchella*

1. Inflorescences most commonly pale yellowish, though ranging to various shades of reddish-purple to purple, especially with age; corollas scarcely exserted from the calyces with usually only the stigma and distal portion of the beak emergent; corollas usually 17–22 mm long, with beaks less than twice the length of the lower lip ..... **Castilleja pulchella**
1. Inflorescences most commonly shades of reddish to salmon and coral, ranging to magenta, only very rarely yellowish; corollas obviously exserted from the calyces with both the beaks and the lower lips conspicuously emergent; corollas usually 23–45 mm long, with beaks twice the length of the lower lips or greater.

2. Stems usually ascending to upright; leaves lanceolate, often broadly so, and mostly entire throughout; calyces usually 15–25 mm long; corollas 23–35(–40) mm long, beaks 7–11 mm long, usually about 3 times the length of the lower lips, lower lip pouches not longitudinally bilobed; endemic to high elevation limestone substrates in the Wallowa Mountains of northeastern Oregon ..... **Castilleja fraterna**

2. Stems decumbent-ascending; leaves usually linear to linear-lanceolate and often entire proximally but almost always cleft into 3 lobes distally; calyces usually 25–34 mm long; corollas usually 28–45 mm long, beaks 8–14 mm long, usually about 2 times the length of the lower lips, lower lip pouches longitudinally bilobed; endemic to high elevation limestone substrates in the Scapegoat Plateau of the central portion of the Rocky Mountains of western Montana ..... **Castilleja kerryana**

ACKNOWLEDGEMENTS

First and foremost, I wish to express my profound appreciation to Peter Lesica, for whom this species might well be named. Pete sent me his first collection of the new species for determination, thereby setting in motion its recognition and description, provided logistics, companionship, and assistance in many ways during our visit to the type locality, and collected many of the voucher specimens for this study. I also thank Dave Hanna of the Nature Conservancy, Becca Hanna, and Jill Owen for companionship and assistance in the field, and Russell and Jill Owen for outfitting and horse packing for our visit to the interior of the Scapegoat Wilderness Area. Hanna also kindly provided me with geological data and references regarding the rock formations in the vicinity of the Scapegoat Wilderness Area. Both Hanna and Lesica provided useful specimens and photos of the new species from locations I was physically unable to visit. Linda Vorobik prepared the superlative illustration of the new species, and Peter Lesica provided useful comments on earlier drafts of this paper. Finally, I thank the personnel of MONTU, RM, and WTU for assistance with loans of specimens.

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Appendix 1. *Castilleja* species of Montana

Castilleja angustifolia (Nutt.) G. Don.
Castilleja cervina Greenm.
Castilleja covilleana Hend.
Castilleja crista-galli Rydb.
Castilleja cusickii Greenm.
Castilleja flava S. Wats.
Castilleja gracillima Rydb.
Castilleja hispida Benth.
Castilleja kerryana J.M. Egger
Castilleja linariifolia Benth.
Castilleja lutescens (Greenm.) Rydb.
Castilleja miniata Douglas ex Hook.
Castilleja minor (A. Gray) A. Gray
Castilleja nivea Pennell & Ownbey
Castilleja occidentalis Torr.
Castilleja pallescens (A. Gray) Greenm.
Castilleja pilosa (S. Wats.) Rydb.
var. *longispica* (A. Nels.) N.H. Holmgren.
Castilleja pulchella Pennell
Castilleja rhexiifolia Rydb.
Castilleja septentrionalis Lindl.
Castilleja sessiliflora Pursh